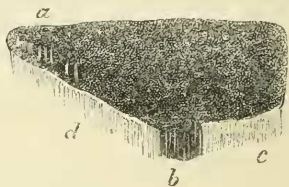


LII.—On the Structure called *Eozoon canadense* in the Laurentian Limestone of Canada. By H. J. CARTER, F.R.S. &c.

I SEE by Dr. Carpenter's "Remarks" in the last number of the 'Annals' that, in my letter to Prof. King on the so-called "*Eozoon canadense*" ('Annals,' March 1874, xiii. p. 189), I did not lay sufficient stress on the *parallelism of the acicular structure with the grains of serpentine*. This is particularly well shown in the illustrations 1, 2, 3, 5, 6, 9, and 10 of Profs. King and Rowney's paper in the Transactions of the Royal Irish Academy, vol. x. p. 506, from which I have taken the liberty of causing to be copied fig. 1, pl. 1, which is reproduced in the following woodcut.

From the "description" of this figure, I learn that it represents "a portion of a 'chamber-cast' from a transparent section of 'eozoonal' ophite from Canada, presented to Dr. Rowney by Dr. Carpenter, as seen by reflected light with a power magnifying 120 diameters."



*a* is the portion of a 'chamber-cast,' *c d* the acicular structure or so-called "tubuli," "nummuline layer," or "nummuline tubulation," and *b* the serpentine seen through the latter.

Now I can testify to this, as well as to all the other illustrations of the kind given in this paper, as being correct instances of the *parallelism* of the aciculæ with the serpentine.

Hence this character is *utterly* incompatible with foraminiferal structure; for the tubuli of the chambers of the testaceous Foraminifera forming in juxtaposition a crust of columnar tubes which keep up a direct communication between the cavity of the chamber and the outer world, necessarily take the shortest course to produce this; and that course is therefore perpendicular to the surface or confines of the chamber and not parallel to it—in other words, a "straight line."

If there be any inclination, it is exceptional and not the rule; for Nature here, as in all other instances, is ever economic of her means.

Now what do we find in the so-called "eozoonal limestone"? that the acicular structure, which has been stated to represent the tubuli, is almost always *parallel* to the serpentine, after the manner shown in the illustration.

Thus, if there be even only one instance where the *parallelism* can be demonstrated, it would show that the aciculæ could

not have been the tubuli of a foraminiferal chamber ; while its general occurrence makes the case conclusive.

It is instructive, if not amusing, to compare the facsimile illustrations of the eozoonal limestone given by the Galway mineralogists with the "constructed" figure of the same given by Dr. Carpenter's artist in the last number of the 'Annals;' and thus it may be understood why I stated to Dr. Carpenter that I had not read any thing that had been written on the opposite side of the question, or words to this effect (*l. c.* p. 278).

Beyond this structure it is not necessary to go for conviction. Of course the tubuli may not be seen in the arenaceous Foraminifera, where *sand* supplies the place of a *calcareous* test, but undoubtedly in the larger testaceous Foraminifera, where the test is formed of lime ; and it so happens that to the structure of these I have heretofore chiefly directed my attention.

Before Schultze's or Carpenter's books were published, I had described and illustrated, in the 'Annals,' the canal-system, "nummuline" tubulation, and general structure of the Foraminifera, both in the recent *Operculina* and in the fossilized *Nummulite* ('Annals,' 1852, vol. x. p. 161, pl. iv.). Even Schultze in his book, as well as I can remember (for I have not the work by me to refer to), gives me the credit of having discovered the "canal-system," which at least proves the priority of my publications ; and since then up to the present time I have more or less occupied myself with the structure of Foraminifera, as my papers in the 'Annals' will show.

Even during the last four years that I have been engaged in the general and microscopical examination of the British-Museum collection of sponges, for the purpose of bringing them into some kind of order and arrangement in that institution, this study has not been neglected ; for, besides a variety of minute Foraminifera which I have found adhering to these sponges, that have come from various parts of the world, I have also had ample means of studying on them the beautiful little roseate *Polytrema* ; so that I am able to speak decidedly of the great resemblance which the late Prof. Schultze is reported in the last number of the 'Annals' to have stated to exist between "*Polytrema* and *Eozoon canadense*."

As regards the "canal-system" in *Polytrema*, my mounted sections do not show any ; nor do I think it should be expected that a foraminiferous structure merely consisting of cells heaped upon one another with wide intercommunications, finally terminated above in more or less erect branches, each of which presents several large trumpet-shaped openings for the exit of the body-sarcode, should require this "system." However it is stated by Schultze to exist ; that is, the "Re-

port" states that "the application of stronger powers shows that in the finer structure of the canals [of the eozoonal limestone?] there is so great an agreement with that of *Polytrema* among the living Acervulinæ, that, weighing all the other conditions of structure which come into consideration, there can be no serious doubt as to the foraminiferous nature of *Eozoon canadense*."

What "canals" are here meant in the translated "Report" it is difficult for me to see—that is, whether they be the "tubuli" or the "canal-system." The term "ramified canal-system" is mentioned in the former part of the "Report," but never the words "nummuline tubulation" or "tubuli." Still, as the position of the latter with respect to the chambers is the *sine quâ non* here, the "ramified canal-system" is, so far, of no consequence.

Thus we come to the identification of the tubuli of *Polytrema* with the aciculæ of the eozoonal structure; and here we have again a repetition of the fact before stated, viz. that in a mounted section of a thin slice of *Polytrema* wherein the tubuli can be best seen, they are in all places observed to pass directly *across* the walls of the chambers—that is, to be perpendicular to the surface or confines of the latter; while in the "eozoonal structure" the aciculæ, which have been stated to be identical with the tubuli, are observed to be *parallel* or tangential to the grains of serpentine.

That is to say, in the section of eozoonal limestone their *ends*, for the most part, may be seen around the grains of serpentine, while in the *walls* of the chambers in the section of *Polytrema* they are always seen to be *sidewise*.

In short the tubuli of the calcareous foraminiferous test are as perpendicular to the confines of the chambers as the lines of enamel to the dentine of a tooth. Now no one, under any circumstances, could make a section of a tooth in which the lines of the enamel would appear otherwise than perpendicular to the dentine; neither could he do the like with a foraminiferous chamber.

How is it, then, that the "aciculæ" to which I have alluded are seen *endwise* (*vide* woodcut) around and not perpendicular to the confines of the grains of serpentine, if the latter be the cast of a foraminiferous chamber?

Either the foraminiferous chambers and their tubuli of the species possessing calcareous tests (for we have nothing to do with arenaceous ones here) belie themselves, which is not likely, or the so-called *Eozoon canadense* in the Laurentian Limestone is *not* a fossilized foraminiferous structure.

That Schultze should have failed to realize this is not extraordinary under the circumstances.